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'The nervous system of Britain': space, time and the electric telegraph in the Victorian age

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Abstract. From its inception, Victorian commentators on the telegraph appeared fascinated by its apparent capacity to break down barriers of space and time. They waxed lyrical over the ways in which the telegraph would bring nations closer together, break down boundaries and foster commerce. They also eulogized the ways in which the telegraph could be used as a seemingly effortless instrument of discipline. A great deal of work was needed to uphold such fantasies and make the telegraph work. This paper highlights efforts to establish a telegraphic time signal from Greenwich as an example of the labour and management required to sustain such rhetoric. Finally, the paper focuses on the increasingly common metaphor linking the telegraph network and the nervous system. It suggests that the metaphor worked for the Victorians because both systems were held to operate through the instantaneous transmission of intelligence as a means of maintaining bodily and social discipline.

Cultural historians of nineteenth-century science and technology are increasingly agreed that the electric telegraph had a crucial role to play in Victorian techno-scientific culture. Commentators have argued that the telegraph, for example, was a key site in the development and articulation of nineteenth-century energetics. Large parts of Victorian physics revolved around the telegraph.[1] Its wires formed the proving ground for new theories and its idiosyncrasies provided new evidences of the mysterious workings of electricity. Physics laboratories as they sprang up during the second half of the nineteenth century shared with telegraph engineering workshops the same regimes of precision measurement and regimented discipline. The telegraph was central as well to imperial expansion. As its wires proliferated across the globe they brought colonial peripheries into ever closer contact with imperial centres of power.[2] Late nineteenth-century telegraphy was

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1 C. Smith and M. N. Wise, *Energy and Empire: A Biographical Study of Lord Kelvin*, Cambridge, 1989; I. R. Morus, 'Telegraphy and the technology of display: the electricians and Samuel Morse', *History of Technology* (1991), **13**, 20–40; G. Gooday, 'Teaching telegraphy and electrotechnics in the physics laboratory: William Ayrton and the creation of an academic space for electrical engineering, 1873–84', *History of Technology* (1991), **13**, 73–111; S. Schaffer, 'A manufactory of ohms: late Victorian metrology and its instrumentation', in *Invisible Connections* (ed. S. Cozzens and R. Bud), Bellingham, 1992, 23–56; B. Hunt, 'The ohm is where the art is: British telegraph engineers and the development of electrical standards', *Osiris* (1993), **9**, 48–63; B. Hunt, 'Scientists, engineers and Wildman Whitehouse: measurement and credibility in early cable telegraphy', *BJHS* (1996), **29**, 155–69.

2 D. Headrick, *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century*, Oxford, 1981; *idem*, *The Invisible Weapon: Telecommunications and National Politics, 1851–1945*, Oxford, 1991.

a key industry. Possession of the expanding network of overland and underwater cables was an important consideration for ambitious and expansionist colonial powers. Building and protecting a telegraph to India, for example, was a key interest of British imperial strategists in the 1850s and 1860s. The Victorians celebrated the telegraph for its capacity to make their world smaller and more immediately manageable.

The telegraph and its possibilities certainly fascinated the Victorians. From the early 1840s onwards there was a steady stream of celebratory literature as a succession of pundits sought to explain the telegraph to their publics. For many the telegraph seemed to epitomize the Victorians' optimistic faith in progress. It was a tangible demonstration of the truly revolutionary changes that a scientific understanding of nature could bring to society. Commentators waxed lyrical over the way in which the new invention made the mysterious fluid, electricity, subservient to mankind. It was as if a way had been found of harnessing the lightning. More than one writer quoted this passage from Job: 'Canst thou send lightnings, that they may go, and say unto thee, Here we are.'[3] One modern commentator has described the telegraph as a 'Victorian Internet', the suggestion being that Victorians responded to the telegraph and its possibilities in much the same way as contemporary users enthuse about the Net.[4] Despite superficial similarities the suggestion is, of course, deeply anachronistic. Victorian understandings of the telegraph were formed and informed by the tangle of assumptions and aspirations that made up their own daily culture.

Central to the Victorian fascination with this new technology was the way in which it acted to transform their notions of time and space. It was comparatively commonplace to assert that the telegraph had 'annihilated time and space'. Similar remarks were made as well about the railways – a revolutionary technology with which the telegraph in its early days was closely associated. They were fascinated as well by the instantiation of discipline provided by the telegraph. It showed on the one hand how electricity, one of the more capricious and mysterious of nature's powers, could be rendered subservient to human intelligence. At the same time it demonstrated how that intelligence could proliferate and impose its discipline increasingly further away from its point of origin. The telegraph was easily seen as an instrument devoted to the spread of Victorian values.[5] Contemporaries were impressed with the comparative speed with which telegraph lines had been extended. Popular expositions of the telegraph during the 1850s in particular made great play with figures demonstrating the massive expansion of telegraph networks in the few years since Wheatstone and Cooke in Europe and Morse in America had made their pioneering breakthroughs. The spread of that network seemed to many to hold out genuine hopes of a revolution in the 'moral and intellectual nature and action of mankind'.[6] The key to that

3 For example, C. M. Archer, *Guide to the Electric Telegraph*, London, 1852, 1; D. Lardner, *The Electric Telegraph*, London, 1855, paragraph 5; W. H. French, *The Railway Spiritualized; to which is added, The Electric Telegraph Moralized*, London, 1858, epigram. The quotation is from Job 37: 35.

4 T. Standage, *The Victorian Internet*, London, 1998.

5 I. R. Morus, 'The electric Ariel: telegraphy and commercial culture in early Victorian England', *Victorian Studies* (1996), **39**, 339–78; *idem*, *Frankenstein's Children: Electricity, Exhibition and Experiment in early Nineteenth-Century London*, Princeton, NJ, 1998, 194–230.

6 'Dinner of the institution of electrical engineers', *Electrician* (1889), **24**, 12–15, 13.

revolution lay in the way in which the telegraph would break down barriers of time and space.

This paper will commence therefore with an overview of some of the Victorians' aspirations concerning the telegraph. The new technology seemed in many ways to hold out limitless possibilities. Projectors puffed and commentators marvelled at the way in which electricity could seemingly be put to work to make the world a smaller place. The telegraph's capacity to convey intelligence at a distance seemed positively magical. The Victorians excelled at combining romanticism with utilitarianism. They found nothing peculiar or paradoxical about viewing industrial progress through the lens of enchantment. The crucial feature of the telegraph to many of its early promoters was its seeming capacity to make intelligence instantaneous. For them, its cardinal virtue was the way in which it could be used to distribute knowledge instantly and evenly over time and space. It was in these kinds of terms, for example, that William Fothergill Cooke outlined the ways in which the telegraph could be used to revolutionize the operation of the railways. It guaranteed the safety of the system by ensuring that the disposition of stock was at any time instantly knowable. This was what also made the telegraph an ideal tool for discipline and surveillance.

A key example of the telegraph's role in imposing discipline through instantaneous knowledge is the establishment of the Greenwich time signal in the early 1850s. Instigated by George Biddell Airy, the Astronomer Royal, the aim of this project was to distribute the Greenwich time signal, and therefore Greenwich time itself, through the telegraph network. The hope was to make possible the standardization of time. Just as important, from the Astronomer Royal's perspective, was the prospect of using signals transmitted by telegraph to coordinate simultaneous observations of astronomical phenomena with observatories throughout Europe. The telegraph could be used to spread the highly disciplined observational regime of Greenwich Observatory at an international level. The episode is instructive in two respects. First, it provides a demonstration of what at least some Victorian protagonists might regard as the possibilities of the telegraph system and the ways in which it could be used to impose particular disciplinary regimes at a distance. Second, and just as important, it makes explicit as well the amount of labour required to maintain such an apparently effortless, seamless web. Embodying intelligence and its transfer in a network of machines required constant human intervention and regulation to maintain the façade of seamlessness.[7]

It is particularly illuminating in this respect that one of the most common metaphors used by Victorian commentators to describe the electric telegraph and its action was the human nervous system. The network of cables spreading over land and sea were the nerves themselves, carrying their electrical messages to and fro. The telegraph office where messages were received, ordered and transmitted was the brain, governing the entire operation. The metaphor worked both ways, of course. The telegraph system was rapidly

7 Compare with the remarks made by H. M. Collins in *Artificial Experts: Social Knowledge and Intelligent Machines*, Cambridge, MA, 1990, 53–61. Collins suggests that we only recognize calculators as performing calculations by eliding over the contributions we, as users, make to the process. The same could be said of Victorian responses to the telegraph.

taken up by physiologists and medical men as a means of illustrating the action of the nervous system itself. Crucial to sustaining this two-way metaphor was the fact that what the telegraph transmitted was intelligence and that the transmission took place instantaneously.[8] The telegraph could be the body politic's nervous system because, according to the Victorians, it really did work in just the same way and achieved the same kind of end. It helped as well that the human nervous system itself was increasingly regarded as working by means of electricity. Victorian popular accounts of the body emphasized how a properly ordered brain maintained discipline over the rest. Hysteria, neurasthenia or even insanity were the results of a breakdown or of some constitutional fault in that ceaseless vigilance.[9] The telegraph seemed to offer that kind of ceaseless vigilance for the body politic. It could do so because its reactions and responses were simultaneous whatever the distance, breaking down the barriers of time and space.

Ruling the waves/waving the rules

In 1889 Lord Salisbury, the then Tory prime minister, looked back at half a century of the electric telegraph as he gave an after-dinner speech before the assembled ranks of the Institution of Electrical Engineers. The telegraph's great virtue, he said, was that it had 'assembled all mankind upon one great plane, where they can see everything that is done, and hear everything that is said, and judge of every policy that is pursued at the very moment those events take place'. It had 'combined together almost at one moment, and acting at one moment upon the agencies which govern mankind, the opinions of the whole of the intelligent world with respect to everything that is passing at that time upon the face of the globe'.[10] The telegraph, in other words, acted as a leveller – a way of uniting humanity across space and time and allowing it to act in unison. This was not an entirely novel observation. Since its inception, commentators and promoters had been eulogizing the telegraph's capacity to break down just such boundaries. Annihilating time and space was a key feature of what the telegraph's projectors promised their potential audiences and customers. The telegraph was used to construct a fantasy of effortless instantaneous communication and discipline that clearly proved highly attractive to many of its Victorian recipients.

Claims concerning instantaneity in communication with the telegraph were underwritten by Charles Wheatstone's experiments of the early 1830s on the velocity of electricity. Using

8 As Bruce Hunt has pointed out, however, the question of the instantaneity of the telegraph system was itself a point of increasing contention at just this time. Problems concerning signal retardation in long underground and underwater cables had a major role to play in defining interest in field theory during the second half of the century. See B. Hunt, 'Michael Faraday, cable telegraphy and the rise of field theory', *History of Technology* (1991), **13**, 1–19; *idem*, op. cit. (1). Telegraph managers and users were also well aware of the delays that could be experienced using long underwater and overground lines. Unsurprisingly, few of these concerns find expression in the frankly celebratory commentaries discussed here.

9 There is an extensive secondary literature on Victorian views of the body – the female body in particular. See J. Oppenheim, *Shattered Nerves: Doctors, Patients and Depression in Victorian England*, Oxford, 1991; C. E. Russett, *Sexual Science: The Victorian Construction of Womanhood*, Cambridge, MA, 1989; E. Showalter, *The Female Malady: Women, Madness and English Culture, 1830–1980*, London, 1987.

10 'Dinner', op. cit. (6), 13.

complex apparatus, Wheatstone had established that the electric fluid travelled at a velocity of more than 280,000 miles per second, faster even than the velocity of light as it was then measured.[11] More than one commentator celebrated the fact that the telegraph represented 'another step towards realizing the dream of the poet' and finding a way to 'put a girdle round about the earth in forty minutes'.[12] According to Dionysius Lardner,

> of all the physical agents discovered by modern scientific research, the most fertile in its subservience to the arts of life is incontestably electricity, and of all the applications of this subtle agent, that which is transcendently the most admirable in its effects, the most astonishing in its results, and the most important in its influence upon the social relations of mankind, and upon the spread of civilization and the diffusion of knowledge, is the Electric Telegraph.[13]

It almost seemed that the telegraph invited hyperbole. Much of this hyperbole concerned the telegraph's effect in achieving 'the practical *reduction* or *annihilation* of TIME'.[14] A corollary of this was the way in which the telegraph was seen as producing a particular kind of intimacy.

Salisbury had argued that the telegraph acted to put 'all mankind upon one great plane'. The popular essayist and medical man Andrew Wynter suggested too that the telegraph allowed everyone to be party to one great conversation. Through the medium of the telegraph, he said,

> We are witness to a series of conversations carried out with all corners of the island, and between the metropolis of the world and every capital of northern and central Europe, as intimately as though the speakers were bending their heads over the dinner table and talking confidentially to the host.[15]

The Bostonian instrument-maker Daniel Davis concurred in this optimistic estimation: 'The time will soon arrive, in this country when, as a means of intercourse at least, its networks will spread through every village, bringing every part of our republic, between the two oceans, into the closest and most intimate relation of friendship and interest.' It made possible 'a wide-spread empire of states, interlinked together, such as our fathers never imagined'.[16] In his original (and originally unpublished) pamphlet extolling the telegraph's virtues, William Fothergill Cooke borrowed Dionysius Lardner's encomium on the railways:

> The concentration of mind and exertion, which a great metropolis always exhibits, will be extended in a considerable degree to the whole realm ... Towns at present removed some stages from the metropolis will become its suburbs; others, now a day's journey, will be removed to its immediate vicinity; and business will be carried out between them and the metropolis, as it is now between distant parts of the metropolis itself.[17]

11 C. Wheatstone, 'An account of some experiments to measure the velocity of electricity, and the duration of electric light', *Philosophical Transactions* (1834), **124**, 583–91.

12 'Preface', *Patent Journal* (1850), **10**, pp. iii–iv, iv.

13 Lardner, op. cit. (3), paragraph 8.

14 G. Wilson, *Electricity and the Electric Telegraph*, London, 1855, 59. Original emphases.

15 [A. Wynter], 'The electric telegraph', *Quarterly Review* (1854), **95**, 118–64, 134.

16 D. Davis, *Book of the Telegraph*, Boston, 1851, 44.

17 'Mr. Cooke's pamphlet or sketch of 1836', in W. F. Cooke, *The Electric Telegraph: Was it Invented by Professor Wheatstone?* 2 vols., London, 1856–7, ii, 239–64, 259.

The telegraph would make the world a smaller place and so increase the unity and mutual interaction of its peoples.[18]

The comparison between the telegraph and railway systems was particularly apposite. The telegraph, in Britain at least, rapidly became closely associated with the railways within very few years of its inception. The connection was largely pragmatic in origin, though many later commentators suggested that the existence of the railway system was in some sense a prerequisite for the telegraph's practical application.[19] The eminent telegraph engineer Latimer Clark, looking back at the telegraph's early history in a presidential address to the Society of Telegraph Engineers, went so far as to suggest the absence of any extensive railway network at that date as the main reason for the failure of one electric telegraph project during the early 1820s.[20] Such judgements were retrospective. Early telegraph promoters nevertheless made strenuous efforts to capture the interests of railway companies as they battled for finance and a market for their fledgling inventions. Cooke, for example, sought to represent the telegraphic system that he and Wheatstone had jointly patented as an essential feature of a well-regulated and economic railway system. The key to the telegraph's role on the railways, according to Cooke, was to be its capacity to deliver instantaneous knowledge of the state of the system.[21]

The telegraph, according to Cooke, had the capacity to deliver a 'bird's-eye view' of the railway system at any given time. He pinpointed what he called 'inflexibility' as the railway system's drawback – the impossibility of allowing for deviations from an absolute schedule. This was the product of ignorance concerning the precise disposition of the system at any given time. The telegraph, however, could provide just such information and therefore make it possible to introduce some flexibility into the system. The telegraph in particular had the capacity to render redundant some of the human characteristics of the railway's employees. The railways' safety depended on 'trusting almost entirely to the alertness and vigilance of their engine-drivers'.[22] By making it possible for the system's controllers to know the state of their railways at any given time, the telegraph could possibly make that trust less entire.[23] The telegraph could operate as a kind of electrical panopticon: 'As a further practical benefit conferred by the Telegraph, unremitting

18 Like the telegraph, as Lardner's remarks indicate, the railways attracted similar attention to that accorded the telegraph during their early years. Much of this rhetoric also made much of the railways' capacity to break down spatio-temporal boundaries. See W. Schivelbusch, *The Railway Journey: The Industrialization of Time and Space in the 19th Century*, Berkeley and Los Angeles, 1986.

19 Morus, 'Ariel', op. cit. (5); Morus, *Frankenstein's Children*, op. cit. (5), 194–7.

20 L. Clark, 'Inaugural address', *Journal of the Society of Telegraph Engineers* (1875), **4**, 1–23, 6–7. The telegraphic project referred to was Francis Ronalds's effort to construct, and interest the Admiralty in, a telegraph worked by frictional electricity. See F. Ronalds, *Description of an Electrical Telegraph*, London, 1823.

21 W. F. Cooke, *Telegraphic Railways; or, The Single Way*, London, 1842.

22 Cooke, op. cit. (21), 10.

23 The prospective replacement of human by machine action was a favourite topic of contemplation for many Victorian commentators. See, for example, C. Babbage, *On the Economy of Machinery and Manufactures*, London, 1832; A. Ure, *The Philosophy of Manufactures*, London, 1835. Some of the ramifications are discussed in W. Ashworth, 'The calculating eye: Baily, Herschel, Babbage and the business of astronomy', *BJHS* (1994), **27**, 409–41; I. R. Morus, 'Manufacturing nature: science, technology and Victorian consumer culture', *BJHS* (1996), **29**, 403–34; S. Schaffer, 'Babbage's intelligence: calculating engines and the factory system', *Critical Inquiry* (1994), **21**, 203–27; S. Schaffer, 'Babbage's dancer and the impresarios of mechanism', in *Cultural*

vigilance and alertness would be enforced, upon all the officers of the division, by the instant and infallible detection at head-quarters of individual remissness.'[24]

The telegraph's operations beyond the railway system required discipline as well. The aptitudes and duties of telegraph clerks were carefully regimented. According to one handbook for hopeful candidates for such a position, a successful telegraph clerk would be expected to 'be capable of writing a free and distinct hand, of spelling correctly, and ... of adapting their communication to grammatical formula'.[25] Beyond such obvious requirements the telegraph companies' employees were expected to submit to a diligent regulatory regime. 'Constant practice' would enable them 'to signal, i.e. to send and receive messages and to write with celerity' and become 'a proficient instrument clerk, correspondent and accountant'.[26] The geography of a telegraph office was carefully laid out:

> Under the galleries at each end of the hall are two long counters, over which are the names of the various places to which messages can be sent. Behind the counter are stationed clerks whose business it is to receive the message, – enter it in a form ... – and pass it to another set of clerks, who transmit it by machinery to the galleries above. Adjoining these are a series of rooms containing the electro-magnetic telegraphs of Messrs. Wheatstone & Cooke. They are placed on desks – and before them are seated the clerks whose province it is to work the apparatus. Each apartment is provided with an electrical clock, shewing true London railway time – which, as our readers know, is observed throughout the departments.[27]

The hopes of its projectors, concerning the telegraph's capacities for discipline and surveillance, extended beyond the railway or telegraph companies' employees. The telegraph's role in policing public order was explicit from the first. In his 1836 pamphlet, Cooke advocated that by using the telegraph 'in case of dangerous riots or popular excitement, the earliest intimation thereof should be conveyed to the ear of Government alone, and a check put to the circulation of unnecessary alarm'.[28] When the Electric Telegraph Company acquired its charter from government in 1846, a clause was inserted allowing the government to take over its lines in the event of national emergency. The clause was duly invoked during the course of the Chartist uprisings of 1848.[29] The key to the telegraph's capacity for surveillance lay in the way in which it could be exploited for

Babbage: Technology, Time and Invention (ed. F. Spufford and J. Uglow), London, 1996, 53–80. For a general overview of early Victorian concerns about machinery see M. Berg, *The Machinery Question and the Making of Political Economy*, Cambridge, 1980.

24 Cooke, op. cit. (21), 33. Bentham's notion of the panopticon was first developed in J. Bentham, *Panopticon: or; The Inspection-house; containing the idea of a new principle of construction applicable to any sort of establishment, in which persons of any description are to be kept under inspection; and in particular to Penitentiary-houses, Prisons, Houses of industry, Workhouses, Poor Houses, Manufactories, Madhouses, Lazarettos, Hospitals, and Schools*, 2 vols., London, 1791. See also M. Foucault, *Discipline and Punish*, London, 1979.

25 R. Bond, *The Handbook of the Telegraph, being a Manual of Telegraphy, Telegraph Clerks' Remembrancer, and Guide to Candidates for Employment in the Telegraph Service*, London, 1862, 1.

26 Bond, op. cit. (25), 2.

27 'The electric telegraph', *Patent Journal* (1850), **4**, 229–31, 229–30.

28 Cooke, op. cit. (17), 250.

29 F. C. Mather, 'The railways, the electric telegraph and public order during the Chartist period', *History* (1953), **38**, 40–53; Morus, *Frankenstein's Children*, op. cit. (5), 224–5.

pre-emptive action. The telegraph only annihilated time and space for its users while leaving others still constrained by conventional spatio-temporal limitations. Authority could maintain its mastery by manipulating time to outmanoeuvre the machinations of the deviant or subversive.

Popular accounts of the telegraph made great play of this anti-subversive capacity. One of the telegraph's first major appearances in the popular press in Britain featured its role in the capture of a fugitive murderer.[30] Shortly after John Tawell had been seen leaving the lodgings of his mistress in Slough, near London, her body was discovered by neighbours. Tawell had been seen, curiously enough, calling at the door of the eminent astronomer John Herschel before embarking on a train to London. A description of the suspect was telegraphed to Paddington station with the result that a policeman was waiting to follow him home to his lodgings and arrest him. Anecdotes proliferated as well concerning the way in which the telegraph had been used to prevent the depredations of petty thieves and pickpockets. Descriptions of known miscreants boarding trains to public events such as racing meetings could be telegraphed ahead, resulting in the arrest of the suspects on arrival, sometimes already carrying the spoils of their nefarious activities.[31] Time was the key factor in all of these anecdotes. Wrongdoers were caught unawares by the telegraph's capacity for conveying intelligence more rapidly than they could travel themselves.

More trivial misdemeanours could also be policed. One anecdote, repeated in more than one source, concerned a 'cunning butcher' who by some ruse succeeded in boarding a train from Derby to Birmingham without paying a fare for his dog. On arrival at Birmingham, however, he found himself accosted and obliged to pay after all. In his own words he had been 'telescoped, by jingo!'.[32] Another popular anecdote concerned the detention of an eloping couple on their way after a telegraphic warning had been sent ahead. Victorian patriarchs, as much as public officials, could exploit the telegraph's aptitude as an instrument of surveillance. As one journal remarked, 'Parents of marriageable children, too, may sleep in tranquility – for Gretna-Green marriages will be hard to effect when the electric telegraph becomes general.'[33] The Victorians' fascination with the telegraph's capacity to subvert time is underlined by the story of a telegraph clerk at Paddington who at the stroke of midnight on 31 December 1844 telegraphed his colleague in Slough to wish him a happy New Year. A message soon arrived that 'the wish was premature, as the new year had not yet arrived at Slough!'.[34] The early Victorians still operated by local time, so that some minutes elapsed between the strokes of midnight at Paddington and Slough. Beneath the humour lay a recognition that the telegraph meant a revolution in perceptions of the relationship between time and place.

30 The incident is treated at length in G. Hubbard, *Cooke and Wheatstone and the Invention of the Electric Telegraph*, London, 1965, 105–12. See also J. L. Kieve, *The Electric Telegraph: A Social and Economic History*, Newton Abbot, 1973, 29–45. For a similar incident involving wireless communication in the early twentieth century see J. E. Early, 'Technology, modernity, and "The Little Man": Crippen's capture by wireless', *Victorian Studies* (1996), **39**, 309–37.

31 Archer, op. cit. (3), 19–51, has an extensive collection of such anecdotes.

32 Archer, op. cit. (3), 39.

33 'The electric telegraph', op. cit. (27), 230–1.

34 'Time and the electric telegraph', *Mechanics' Magazine* (1845), **42**, 416. The anecdote is repeated in Archer, op. cit. (3), 34.

Many Victorian commentators were unapologetic in their romanticization of the telegraph, as they were of the romanticization of industrial culture in general. The new invention 'far exceeds even the feats of pretended magic and the wildest fictions of the East'. It would achieve 'a thousand times more than what all the preternatural powers which men have dreamt of and wished to obtain were ever imagined capable of doing'.[35] It was a 'spirit like Ariel to carry our thoughts with the speed of thought to the uttermost ends of the earth'.[36] The telegraph was favourably compared to the efforts made by ancient magi using sympathetic lodestones by means of which 'friends talked together across a whole continent, and conveyed their thought to one another in an instant over cities or mountains, seas or deserts'.[37] Latimer Clark pointed to Joseph Glanvill's *Scepsis Scientifica* of 1665 as an early prediction of what modern science could achieve over the failure of magic.[38] The electrician William Robert Grove underlined the telegraph's wondrousness with the thought that

> had it been prophesied at the close of the last century that, by the aid of an invisible, intangible, imponderable, agent, man would, in the space of forty years, be able ... in the communication of ideas, almost to annihilate time and space; – the prophet, Cassandra-like, would have been laughed to scorn.[39]

Dionysius Lardner repeated the suggestion in much the same terms a little over a decade later.[40]

Victorian commentators almost unanimously regarded the telegraph as a technology that had had a profound effect on their perceptions of time. It broke down conventional assumptions concerning the relationship between time, place and distance. As Latimer Clark put it, 'distance and time have been so changed to our imaginations, that the globe has been practically reduced in magnitude, and there can be no doubt that our conception of its dimensions is entirely different to that held by our forefathers'.[41] By breaking down these conventional barriers, particularly by making intelligence available simultaneously at spatially distant points, the telegraph could be seen as a new panopticon.[42] It enabled the centre to know what was going on at its peripheries. The physical task of overseeing the expansion of the telegraph network across the empire was the occasion as well for travellers' tales recounting imperial exploits and extolling this new addition to civilization and its powers.[43] Some Victorians celebrated this as the epitome of levelling. The telegraph's shrinkage of time and space might inaugurate a new intimacy in human interaction. While the telegraph was lauded as a means of realizing and even superseding once fantastical leaps of imagination, contemporary commentators laboured under no illusions about what made that realization possible. The key to the telegraph (and

35 W. J. Coplestone, *Memoir of Edward Coplestone, D.D., Bishop of Llandaff*, London, 1851, 169.

36 [Wynter], op. cit. (15), 119.

37 'The electric telegraph', op. cit. (27), 231.

38 Clark, op. cit. (20), 2–3.

39 W. R. Grove, *On the Progress of Physical Science since the Opening of the London Institution*, London, 1842, 24.

40 Lardner, op. cit. (3), paragraph 5.

41 Clark, op. cit. (20), 2.

42 Bentham, op. cit. (24).

43 F. Goldsmid, *Telegraph and Travel*, London, 1874.

according to many Victorians the key to much else as well) was organized, disciplined labour. Maintaining the telegraph's conquest of time itself took time and effort.

The telegraph's conquest of time was not uncontested, however. Despite the fulsome hopes and aspirations of its promoters, the telegraph had its share of opponents and subversives. Many users chafed against the loss of control over their own communications which they suffered as they handed their transmission over to telegraph clerks and monolithic companies. Complaints abounded concerning the prohibitive charges that British telegraph companies in particular demanded for their services. Some users complained that the telegraph companies were misappropriating and exploiting the intelligence with which they were entrusted.[44] Others learned quickly that they could turn the telegraph to their own purposes. During the Chartist agitations of the late 1840s, for example, there is some evidence that the Chartists themselves, as well as the government, were using the telegraph in an effort to coordinate their actions. At one stage John Lewis Ricardo, the Electric Telegraph Company's chairman, demanded police protection for his clerks against threats from Chartist agents.[45] Later in the century, colonial agents and others grew adept at turning the telegraph to their own local purposes rather than those of their imperial masters in London and elswhere.[46] The telegraph's users were in many ways select and self-selecting as well. Not everyone could afford to subscribe to its promoters' seductive hard sell of instant communication.[47]

Greenwich time/Greenwich space

One mid-century project in particular illustrates very well the Victorians' aspirations concerning the telegraph's possibilities. It provides an excellent example also of the amount of work required to put together and maintain these new technological networks. The project, instigated by George Biddell Airy, the then Astronomer Royal, was to use the nascent telegraph system as a means of making Greenwich time available throughout Britain and ultimately throughout the world. Before the middle of the nineteenth century, different communities throughout Britain (and elsewhere) typically operated on local time. Midday was locally calculated according to the sun's position. The proliferation of the railway networks from the 1830s onwards brought about increasing pressure to introduce a standardized system of time. Railways usually operated on London time throughout their networks so that timetables and station clocks showed London rather than local time. By

44 Morus, 'Ariel', op. cit. (5), 368–72; Morus, *Frankenstein's Children*, op. cit. (5), 223–9.

45 Mather, op. cit. (29), 50.

46 D. Headrick, *The Tentacles of Progress: Technology Transfer in the Age of Imperialism, 1850–1940*, Oxford, 1988, 107.

47 Many commentators have recently drawn attention to the ways in which categories of 'class' and 'public' were in the process of being redefined throughout the Victorian period. It is arguable that the telegraph provided an important material resource in such transformations. 'Victorians' as inhabitants of a particular kind of public space were being defined through their access to and use of technologies like the telegraph, as well as through their endorsement of the kind of progressive fantasy being described here. Such a definition was clearly exclusionary. Those who could not or would not participate were as a result more easily written out of the public sphere. See P. Joyce, *Democratic Subjects: The Self and the Social in Nineteenth-Century England*, Cambridge, 1994; D. Wahrman, *Imagining the Middle Class: The Political Representation of Class in Britain, c. 1780–1840*, Cambridge, 1995.

the end of the 1840s Airy was actively campaigning to connect the Greenwich Observatory to the telegraph network so as to be able to transmit the midday Greenwich time signal by telegraph throughout Britain.[48]

In 1849, when Airy suggested to the Observatory's visitors that the telegraph could be 'employed to increase the general utility of the Observatory, by the extensive dissemination throughout the Kingdom of accurate time-signals, moved by an original clock at the Royal Observatory', he had already been Astronomer Royal for fourteen years.[49] Airy was well known for the strict disciplinary regime he had introduced at Greenwich. The Observatory was organized according to a 'factory mentality'.[50] The work of observation, recording and calculation was ordered according to a strict division of labour. Mental, as much as manual, productivity could be increased by proper attention to the principles of political economy. Like his fellow Cambridge graduate Charles Babbage, Airy was convinced that the drudge work involved in astronomical calculation was best carried out, if not by machines, then by drudges working in a strict and ordered regime.[51] For Airy, as Simon Schaffer has suggested, the plan to link Greenwich to the telegraph network was a self-evident extension of the disciplinary hierarchy already in place in the Observatory. Working to time was key to Greenwich's productivity – the telegraph could be exploited to spread disciplined timekeeping beyond the Royal Observatory's boundaries. Putting the Observatory to work in this way would ensure that it carried on 'quietly contributing to the punctuality of business through a large portion of this busy country'.[52] As E. P. Thompson has observed, time discipline was an essential feature of Victorian capitalism. Airy would have concurred.[53]

One of Airy's first acts in pursuit of his goal of establishing telegraphic time was to contact the proprietors of the South Eastern Railway Company, who operated the London Bridge to Dover line, which passed near Greenwich. The South Eastern Railway was unusual in that it operated its own telegraph rather than employing the services of the Electric Telegraph Company. Airy was therefore soon placed in contact with Charles V. Walker, the railway company's superintendent of telegraphs, with a view to establishing the best way of achieving his objectives. Airy was fortunate in that Walker was a keen and enthusiastic electrician. He had been a member of the short-lived London Electrical Society and had been its secretary and treasurer before its collapse. He had also briefly edited the *Electrical Magazine*.[54] The London Electrical Society had been founded in 1837, largely at

48 D. Howse, *Greenwich Time*, Oxford, 1980; D. Howse, *Greenwich Time and the Longitude*, London, 1997, 95–105.

49 Airy, quoted in Howse, *Longitude*, op. cit. (48), 95.

50 Quoted in S. Schaffer, 'Astronomers mark time: discipline and the personal equation', *Science in Context* (1988), **2**, 115–45, 121. See also A. Chapman, 'Sir George Airy and the concept of international standards in science', *Vistas in Astronomy* (1985), **28**, 321–8.

51 Babbage, op. cit. (23), 191–6. For political economy, machinery and the division of labour see Berg, op. cit. (23). For Babbage in particular see W. Ashworth, 'Memory, efficiency and symbolic analysis: Charles Babbage, John Herschel and the industrial mind', *Isis* (1996), **87**, 629–53.

52 Airy, quoted in Schaffer, op. cit. (50), 121.

53 E. P. Thompson, 'Time, work-discipline and industrial capitalism', in *Customs in Common*, Harmondsworth, 1993, 352–403.

54 I. R. Morus, 'Currents from the underworld: electricity and the technology of display in early Victorian England', *Isis* (1993), **84**, 50–69; Morus, *Frankenstein's Children*, op. cit. (5), 99–124.

the instigation of William Sturgeon, and envisaged as providing a forum for collaborative experimentation on a grand scale and for the promulgation of electrical knowledge. As a prominent former member of the society and an experienced electrical experimenter, Walker was in a good position both to understand the significance of Airy's project and to recognize the best means of achieving his goal.[55]

The project's initial objectives were threefold:

> 1. To transmit Greenwich time and corrected time to and from the clock at the New Houses of Parliament and the Royal Exchange. 2. To transmit Greenwich time throughout the kingdom by the various lines of electric telegraph. 3. To compare the transit of stars at Greenwich with the same at Paris.[56]

From the purely astronomical perspective, the last goal was clearly the most important. The capacity to compare observations simultaneously between London and Paris (and later with other continental observatories) could lead to far more accurate determinations of longitude. The aim to transmit Greenwich time directly to the main centres of government and commerce as well as throughout the country generally was an indication, however, of the extent to which Airy envisaged his Observatory as fitting into a more general bureaucratic state matrix. Greenwich would become the centre of a network of clocks, all working together through the electric telegraph system to sustain a standardized, centralized reckoning of time. Greenwich time would be placed at the service of commercial and imperial expansion.

The plans worked out by Airy and Walker appeared comparatively straightforward in essence. An electric clock would be installed at Greenwich, set up so that it provided a number of 'slave' clocks at the Observatory and elsewhere with an electrical impulse every second ensuring they all kept the same time. At prearranged times (such as noon), the relevant telegraph wires would be denied to other traffic so that time signals generated by the main clock at Greenwich could be sent out automatically along the cables.[57] The system was designed both for maximum accuracy and for minimum disruption of any other use of the wires. The same principle would apply to communications for the purposes of comparing astronomical observations between London, Paris and elsewhere. A prearranged time would be allocated for observation, during which period the telegraph wires would be cleared of any other signals:

> Mr. Airy at Greenwich, and M. Arago at Paris, will thus be able to fix a time when the eye of each shall be directed to the same star at the same time, and signal to each other as each wire [of the transit instrument] is passed.[58]

The apparent straightforwardness of the proposals masked, however, the labour and organization that went into their realization. Although Airy had been corresponding with

55 Walker presented Airy with a copy of his *Electric Telegraph Manipulations*, hoping that he would 'find it useful for references in respect upon capabilities that exist for carrying out your plans of transmitting time signals'. C. V. Walker to G. B. Airy, 21 March 1850. RGO 6/610. Cambridge University Library (CUL).

56 [C. V. Walker], 'Time signals and transit signals', *The Times*, 11 February 1852, 8–9, 8.

57 [Walker], op. cit. (56) gives a relatively detailed account of the mechanics involved in the process.

58 [Walker], op. cit. (56), 8.

Walker on the matter since at least mid-1849, no concerted effort was made to bring the project to fruition until 1851. Airy had on the one hand to convince the Admiralty and the Board of Works of the viability of the project and its advantages while on the other hand convincing the Boards of Directors of both the South Eastern Railway Company and the Electric Telegraph Company that it would be to their advantage to facilitate the proposals. From September 1851 Airy was working with Walker to prepare a draft agreement with the South Eastern Railway Company on the matter.[59] It was not until January the following year that Walker could report that 'the question of time-wires has finally passed our Board. I hold instructions dated yesterday to commence'.[60] At about the same time, Airy heard from the Board of Works that permission had been granted to lay wires from the Observatory, through Greenwich Park, to the railway company's lines.[61] In the meantime, while the directors of the Electric Telegraph Company expressed every willingness 'to give every assistance to any undertaking in connection with the Electric Telegraph of a public or scientific nature', they insisted that

> no system of corresponding signals whatsoever given by means of a galvanic current through insulated wires can be practically carried out without the infringement of the original patent of Messrs Cooke and Wheatstone as to the principle, and many of the subsequent patents of the Company as to the form.[62]

They suggested royalties of ten shillings per mile.

Once negotiations with the various parties were completed and funding from the Admiralty assured, work proceeded comparatively rapidly. The telegraphic connection between the Royal Observatory and the South Eastern Railway Company's line at Lewisham was completed by 17 February 1852. It was not until 4 June, however, that the electric clock, designed by Charles Shepherd, who held the patent for the electric clock displayed at the Great Exhibition the previous year, was installed at Greenwich. Once everything was in place, tests of the instruments commenced at the beginning of August and in a few weeks Walker was able to report to Airy that 'I delayed updating progress until the preliminary experiments were completed, and the connections permanently made and duly adjusted, which is now the case. I consider that the time-signals have properly commenced at noon yesterday, Aug. 19th'.[63] Everything was in place for national distribution of the time signal by the end of August. Initially, all signals were first directed to the South Eastern Railway Company's switching room at the London Bridge terminus and from there to the Electric Telegraph Company's offices in Lothbury from where they could be further distributed over the telegraph network.[64]

Setting up the crucial cross-channel link between Greenwich and Paris required further intense negotiation. The link depended on the cooperation of the Submarine Telegraph Company, which operated the undersea telegraph cable between Dover and Cape Gris-Nez

59 RGO 6/610. CUL, *passim*. See, for example, C. V. Walker to G. B. Airy, 30 September 1851.
60 C. V. Walker to G. B. Airy, 21 January 1851 [means 1852]. RGO 6/610. CUL.
61 T. W. Philipps to G. B. Airy, 28 January 1852. RGO 6/610. CUL.
62 ETC to G. B. Airy, 13 October 1851. RGO 6/610. CUL.
63 C. V. Walker to G. B. Airy, 20 August 1852. RGO 6/611. CUL.
64 Howse, *Longitude*, op. cit. (48), 97–100.

in France. The first cross-channel cable had been laid only a few years previously in 1850. Airy was soon in correspondence with Lord de Mauley, the chairman of the Submarine Telegraph Company's board of directors, hoping to persuade him of 'the anxious desire of the authorities of the Observatory of Paris and myself, to establish a galvanic communication (to be used on some very rare occasions only) between the Observatories of Paris and Greenwich, for the transmission of Time Signals'.[65] The directors needed to be persuaded of the national importance of the project, that it would not interfere with the commercial working of their line and that it would not be exploited for any other purpose. Bringing the project to fruition required more than hardware and human labour. It required the marshalling and careful disposition of a whole range of diverse interests whose continued cooperation was essential to the enterprise's success.

With the wires in place and the different interests enrolled, making the time signals work still required intensive effort. Ways had to be found of making sure that the electrical, human and mechanical elements of the system worked together efficiently. Exhaustive tests were carried out over the telegraph lines between Greenwich and Dover comparing, for example, the recorded signals at the two ends of the line and searching for possible sources of error. The human operators frequently failed to record the time of signalling sufficiently accurately. There were instances when one or the other of the clocks recording the time failed to work properly. Airy marked next to the figures on one of the tables, 'I do not doubt that there is an error of a beat of the chronometer.' On at least one occasion, despite precautions that had been taken to prevent message and time signals from being sent down the line at the same time, Airy recorded that 'there was some confusion. A message signal was taken for a time signal and afterwards two were lost'.[66] Repeated practice was required to familiarize the operators with the system's idiosyncrasies.

Even the business of simply watching for the signal was not straightforward. Something as simple as the angle at which the clock face was oriented could affect the accuracy of the readings. Airy noted his own experience:

> I believe that the principal errors on my part arose from the circumstance that I had not tilted the chronometer-face properly, and therefore I was disturbed by the parallax of the seconds-hand on the divided circle. It is very difficult to carry-through the count with a half-seconds chronometer, and every care must be taken to place the chronometer-face in a position convenient for reading very quickly.

Airy suggested that one way of preventing problems of coordinating signals with the proper time was to have the observations carried out by a team rather than by an individual: 'The observer ought to have a quiet person standing behind him, who will count the warning-signals, and will also count the signals received, and will give notice when they have come to an end.'[67] As tests moved forward, human error was increasingly pinpointed as the primary cause of breakdowns in the system.[68]

The problem faced by Airy, Walker and their collaborators in ensuring the proper operation of their time-signalling system was that they were obliged to test the technology

65 G. B. Airy to Lord de Mauley, 9 March 1853. RGO 6/610. CUL.

66 'Galvanic signals between Greenwich and Dover', 1 March 1853. RGO 6/611. CUL.

67 'Galvanic signals', op. cit. (66), 5.

68 See, for example, G. B. Airy to Latimer Clark, 19 June 1854. RGO 6/611. CUL.

and the personnel operating it simultaneously. In setting up a previously untried system they had no guarantee either of the robustness and reliability of their machinery or of the trustworthiness and integrity of the human operators. Their difficulty was related to the endemic problematic of all experimental practice in open settings, characterized by the sociologist Harry Collins as the experimenter's regress.[69] There was no external means of determining whether either the apparatus or its operators were performing reliably. Airy had the choice of either trusting the machines or trusting the workers. Unsurprisingly, given his enthusiasm for the factory system, as tests proceeded he placed more and more trust in the apparatus and less in the integrity and reliability of the workforce.[70] Maintaining a telegraphic system that could reliably distribute a standardized time over large distances was therefore contingent in the end on some very local choices. Underpinning its robustness was a delicate balance of interests and circumstantial decisions.

The outcome of the Greenwich experiment was, however, clear. The result, according to one quite typical contemporary commentary, was that

> we may soon expect to see every series of telegraph-wires forming part of a gigantic system of clockwork, by means of which, time-pieces, separated from each other by hundreds of miles, may be made to keep exactly equal time, and the clocks of a whole continent move, beat for beat, together.[71]

The key consequence would be to make a localized expertise into a universal commodity: 'wherever we choose to stretch the telegraph-wires throughout the length and breadth of the land, we could set up a clock and read on its face the evidence of the care which the far distant astronomer bestowed on his observatory clock'.[72] It is worth noting that the only human left in this picture was the 'distant astronomer'. The relays of observers and recorders, telegraph clerks and operators and electricians that sustained the integrity of the system had been subsumed inside its machinery. As Walker noted, what the time signal did from the perspective of its consumers was reduce labour. Everyone would be able to 'set out and rate his chronometers without the expense and care that is at present incurred'.[73]

By the end of the nineteenth century, Greenwich time was ubiquitous. Despite quite frequently vociferous local opposition, local time was gradually discontinued as standardization became the goal. In 1870 the Post Office took over all telegraphic services, including distribution of the Greenwich time signal, and in 1872 instructed all Post Office buildings throughout the country to maintain Greenwich time. In 1880 Greenwich time was adopted as the legally enforceable measurement of time throughout Britain and Ireland. Four years later it became the world standard time. In 1888, when the Astronomer Royal proposed that the 10.00 a.m. time signal from Greenwich should be discontinued, the Post Office protested vehemently:

69 The notion of the experimenter's regress is fully spelt out in H. M. Collins, *Changing Order*, London, 1985, especially 83–84.

70 Trust has become a crucial parameter in recent historiographical discussions of science. See S. Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England*, Chicago, 1994.

71 Wilson, op. cit. (14), 59–60.

72 Wilson, op. cit. (14), 63–4.

73 [Walker], op. cit. (56), 9.

> But for what purpose was Greenwich Observatory established if it was not for the production of accurate time for national and imperial objects; and what object is of more consequence to the Government than the distribution of accurate time throughout the three kingdoms to every post office and railway station?[74]

Telegraphic time had become an indispensable prerequisite of bureaucratic and everyday life. It was the ultimate recalibration. Not only did the telegraph make the transmission of intelligence instantaneous, it provided a universal grid against which that instantaneity could be measured.[75]

'This ingeniously constructed sensorium'

One of the most common metaphors found in discussions of the telegraph and its potential by Victorian commentators was the comparison between it and the nervous system. The metaphor remained practically ubiquitous throughout the nineteenth century almost from the new technology's inception. It was a two-way metaphor as well. Just as discussions of the telegraph invoked the nervous system to make sense of their subject matter, accounts of the nervous system and its operations drew on the telegraph and its networks of wires as a way of making simple the complexities of their subject matter. Victorians saw the telegraph and the nervous system as potentially having many things in common. Both were systems that seemed to transmit intelligence instantaneously. Both systems were to do with regulation. As Sir George Gabriel Stokes pointed out, responding to Lord Salisbury's paean to the telegraph at the Institution of Electrical Engineers:

> Nowadays the whole earth resembles, in a measure, one of our own bodies. The electric wires represent the nerves, and messages are conveyed from the most remote regions to the central place of government, just as in our bodies, where sensations are conveyed to the sensorium. *And then, again, the orders are issued.*[76]

Many argued that they shared the same mechanism as well since the nervous system, like the telegraph, worked by means of electricity. Comparisons between bodies and machines were certainly not new to the Victorians. They were familiar, for example, with analogies drawn between factory workers and the machines they operated.[77] The telegraph, however, offered a new and powerfully versatile set of images.

Describing the Electric Telegraph Company's head offices in Lothbury, Andrew Wynter went into considerable detail as to how this kind of analogy worked:

> Jammed in between lofty houses at the bottom of a narrow court in Lothbury, we see before us a stuccoed wall, ornamented with an electric clock. Who would think that behind this narrow forehead lay the great brain – if we may so term it – of the nervous system of Britain, or that beneath the narrow pavement of the alley lies its spinal chord, composed of 224 fibres, which transmit intelligence as unperceived as does the medulla oblongata beneath the skin?[78]

74 Quoted in Howse, *Longitude*, op. cit. (48), 105.

75 For comparative accounts of time standardization in the United States see C. Stephens, 'The most reliable time: William Bond, the New England railroads and time awareness in 19th-century America', *Technology & Culture* (1989), **30**, 1–24; I. R. Bartsky, 'The adoption of standard time', *Technology & Culture* (1989), **30**, 25–56.

76 'Dinner', op. cit. (6), 13. My emphasis.

77 Babbage, op. cit. (23); Ure, op. cit. (23).

78 [Wynter], op. cit. (15), 132.

His task, like that of other commentators on the revolutionary technology, was that of the physiologist dissecting the organism and laying its operations bare before the public:

> The physiologist, minutely dissecting the star fish, shows us its nervous system extending to the tip of each limb, and descants upon the beauty of this arrangement, by which the central mouth is informed of the nutriments within its reach. The telegraphic system, already developed in England, has rendered her as sensitive to the utmost extremities as the star fish.[79]

The key to the comparison was the dissemination of intelligence and the sensitivity that the two systems shared.

John Timbs, prolific author and editor of the annual *Year Book of Facts*, described the metropolis's telegraph system as 'the nerves of London'. He was impressed by the spectacle it presented 'stretching across the sky-line of great thoroughfares, and visibly triangulating the town in every direction'.[80] Another writer speculated that 'such a network of wires, we may hope, will one day connect together the ends of the earth; and, like the great nerves of the human body, unite in living sympathy all the far-scattered children of men'.[81] The American historian of the telegraph, George Prescott, took the comparison furthest:

> The telegraph, in its common form, communicating intelligence between distant places, performs the function of the sensitive nerves of the human body. In the fire telegraph it is made to act for the first time in its motor function, or to produce effects of power at a distance; and this is also connected with the sensitive function, through a brain or central station, which is the reservoir of electric or nervous power for the whole system. We have thus an excito-motory system, in which the intelligence and volition of the operator at the central station come in to connect sensitive and motor functions, as they would in the case of the individual. The conditions of municipal organization absolutely compelled the relation of circuits which has been described.[82]

For Prescott the analogy had the power of natural law.

This permeability in the boundary between the natural and artificial worked in both directions. Just as Andrew Wynter or George Prescott described the telegraph as a nervous system, doctors could point to electricity and the telegraph to explain the working of the body. Alfred Smee, in his ambitious *Elements of Electro-biology*, sought to construct a comprehensive picture of the human body based on electricity. The brain was the central battery connected with and acting upon the body's extremities through a network of 'bio-telegraphs'.[83] The whole body, argued Thomas William Nunn, could be regarded as an electrical circuit:

> The ovaria and mammae form, as it were, a reproductive pile, the circuit being completed by the nervous system. If there be no antecedent ovarian excitement, no impulse is transmitted to the breast. As in the galvanic battery, if no chemical action takes place at one pole, no electric current traverses the wire and no sign is elicited at the other.[84]

Some of the comparisons could be quite detailed. William Benjamin Carpenter described the 'cylinders of fatty matter' surrounding nerve cores as

79 [Wynter], op. cit. (15), 142.
80 J. Timbs, *Wonderful Inventions*, London, 1868, 355.
81 Wilson, op. cit. (14), 77.
82 G. B. Prescott, *History, Theory and Practice of the Electric Telegraph*, Boston, 1860, 242.
83 A. Smee, *Elements of Electro-biology*, London, 1849, Appendix: 'Electro-biological Map No. 1'.
84 T. W. Nunn, *Inflammation of the Breast and Milk Abscess*, London, 1853, 3–4.

> acting as insulators, like the gutta-percha or other insulating material round our telegraph wires. Each of the telegraph cords that cross our streets, holds about sixty wires; and every wire has its separate origin and termination. As with these wires, so with the nerve-fibres; each has its separate origin and termination, and must therefore be insulated, in order that it may be functionally independent of those with which it is bound up in the same nerve-trunk.[85]

The philosopher William Robert Grove suggested that the voltaic battery was 'the nearest approach man has made to experimental organism'.[86]

Many Victorian physiologists and medical men saw regulation as a key function of the nervous system. It acted as a mediator between the mind and the body. The nerves acted by passing intelligence back and forth between the body's extremities and the brain, thus allowing the brain to oversee and control the various functions of the bodily organs. The controversial physiologist Marshall Hall elaborated a complex 'excito-motory' system whereby this regulatory role played by the nervous system could take place automatically, without the intervention of the will. His work was extended by later Victorian physiologists such as Thomas Laycock and William Benjamin Carpenter to account for mental dysfunction in terms of a breakdown in this automatic regulatory system.[87] Nerves acted as the conduits that conveyed the brain's authority throughout the body. If the system broke down then the body was left without regulation. The key was the instantaneous transfer of intelligence back and forth. When information went astray, was lost or took too long to arrive at its destination, mental or nervous breakdown ensued.

Although Marshall Hall had regarded reflex action as taking place within a separate nervous system dominated by the spinal cord, both Carpenter and Laycock regarded the cerebrum also as a centre for reflex action. Carpenter in particular posited a hierarchy of reflex actions ranging from the purely automatic, taking place entirely within the excito-motory system, through the consensual, which although independent of the will required consciousness for their performance, to the ideo-motor, which although remaining automatic were accompanied by distinct intellectual states.[88] By the 1870s Carpenter was using this model of human mental and nervous action as a weapon to oppose what he regarded as the dangerously materialist theories of Huxley and others concerning human behaviour.[89] While more than happy to concede – indeed to claim credit for having played a role in establishing – purely automatic behaviour at the reflex level, Carpenter was adamant that there existed gradations of automatism which merged into actions that could only be described as intellectual. In particular he insisted on the existence of a class of automatic actions which were learnt. By constant repetition, actions that had originally

85 W. B. Carpenter, 'On the physiological import of Dr. Ferrier's experimental investigations into the functions of the brain', *West Riding Lunatic Asylum Medical Reports* (1874), **4**, 1–23, 3. See also W. B. Carpenter, 'The unconscious action of the brain', *Science Lectures for the People, Third Series*, Manchester, 1871, 10.

86 W. R. Grove, 'An address on the importance of physical science in medical education', *British Medical Journal* (1869), **1**, 485–7, 486.

87 Morus, *Frankenstein's Children*, op. cit. (5), 240–8; A. Winter, *Mesmerized: Powers of Mind in Victorian Britain*, Chicago, 1998, 287–90.

88 The distinctions are discussed in E. Clarke and L. S. Jacyna, *Nineteenth-Century Origins of Neuroscientific Concepts*, Berkeley and Los Angeles, 1987, 114–48.

89 W. B. Carpenter, *Is Man an Automaton? A Lecture Delivered in the City Hall, Glasgow on 23rd February 1875*, London, 1875; *idem*, *Nature and Man: Essays Scientific and Philosophical*, London, 1888.

been voluntary – under the control of the intellect – became automatic and independent of the will.

Interestingly, one of Carpenter's main examples of this kind of 'secondary' or acquired automatism was the behaviour of telegraph clerks. According to Carpenter, 'it is no uncommon experience in telegraph offices, for transmitters of messages, when they have been for some time in the service, to work the instruments without conscious thought of what they are doing'.[90] In doing this, in the words of one of Carpenter's informants, they were acting just like the apparatus itself: 'They read the words ... pass them through their minds, and transfer them to the sending part of the apparatus, just as unconsciously and automatically as Wheatstone's transmitter does.'[91] In this view, the mental processes of telegraph clerks really were just like the pulses of electrical intelligence flowing through the telegraph wires. These same instruments were increasingly to be found in physiological laboratories and telegraph workshops as well. Apparatus designed to follow the flow of electricity through the telegraph system could be put to work to follow the electrical activity of the human brain and nervous system.[92] The homology of the telegraph and nervous systems was quite literally reconstructing the ways in which Victorians perceived their own bodies.[93]

There was a close link between this perceived homology of the nervous system and the telegraph on the one hand and the image of the telegraph as a technology that worked by breaking down time on the other. The telegraph was like the nervous system precisely because both systems acted – ideally at least – instantaneously. In the same way that the nervous system imposed a kind of regulatory grid on the body under the supervision of the mind, the Victorians saw the telegraph as imposing such a grid on the body politic. Critically, nerves were like the telegraph because what was being transmitted was instantaneous intelligence. Both systems were seen to depend not only on this instantaneous transmission but on the fact that the intelligence being transmitted constituted knowledge of the system itself. Just as the nerves allowed the brain to know the body at any given moment in time, the telegraph network also allowed its operators to know the system at any given moment. This, for example, was just how William Fothergill Cooke had envisaged the telegraph's role in regulating the railways.[94] There was also a strong sense that this kind of regulation was an inherent feature of both systems rather than being externally imposed. As George Prescott suggested, it was in both cases an expression of natural law.[95]

90 W. B. Carpenter, 'The limits of human automatism', in *idem*, *Nature and Man*, op. cit. (89), 284–315, 293.

91 Carpenter, op. cit. (90), 293.

92 T. Lenoir, 'Helmholtz and the materialities of communication', *Osiris* (1993), **9**, 185–207; I. R. Morus, 'The measure of man: technologizing the Victorian body', *History of Science* (1999), **37**, 249–82.

93 Some more general Victorian concerns about their bodies' relationships to electricity, particularly with reference to forms of communication, are canvassed in C. Marvin, *When Old Technologies were New: Thinking about Electrical Communication in the Late Nineteenth Century*, Oxford, 1988.

94 Cooke, op. cit. (17), 10.

95 Prescott, op. cit. (82), 242.

Conclusion

The telegraph appeared to many Victorians as the ultimate symbol of man's power over nature. It was a technology that harnessed the lightning and put it to work for man's pleasure. Electricity was widely regarded as the most capricious and least understood of nature's forces. That they could still make it their servant seemed to the Victorians a powerful indicator of the advance of civilization. It was the telegraph's apparent capacity to overcome time in particular that fascinated them. The revolution it brought about in the speed of communication between distant places seemed unprecedented. Information that would have taken several days to arrive at its destination in 1840 could be there in a matter of seconds in 1850. It was an indispensable tool for commercial and imperial expansion. It was no coincidence that, as contemporary commentators noted, financial speculators were amongst the earliest and most prolific users of the telegraph. The military were also soon alerted to its potentials. By the time of the Crimean War in the mid-1850s the telegraph offered unprecedented access to front-line events. This was not an unmixed blessing. The telegraph made possible unprecedented access to newspaper correspondents as well.

The telegraph's apparent capacity to break down barriers of space and time meshed well with other Victorian preoccupations. Discipline was a key Victorian value. Properly regulated minds and bodies were esteemed as the hallmarks of a gentleman on the one hand while being recognized as the prerequisites of productive labour on the other. Victorian gentlemen were encouraged to regulate carefully their actions while Victorian workers, whether they liked it or not, were obliged to regulate their lives according to the rhythms of the machinery they increasingly operated.[96] The telegraph seemed an ideal aid to such regulation. It disciplined its operators and its users, even to the extent of regulating their language. As Andrew Wynter ruefully noted, 'The telegraphic style banishes all the forms of politeness.'[97] Beyond this, the telegraph ordered the world meticulously. The timetables that enabled the fictional Phileas Fogg to travel around the world in eighty days were a product of this idealized telegraphic culture.[98] In his world the telegraph superimposed a grid of orderliness over an otherwise disorderly nature. That was also the hoped-for outcome of Airy's project of transmitting Greenwich time. It would replace natural, and cultural, diversity with disciplined uniformity.[99]

Discipline, in this Victorian fantasy, was bolstered by intelligence. Thomas Richards has documented the late Victorian concern with gathering and classifying intelligence.[100]

96 For similar considerations on mechanism and management see E. Green Musselman, 'The governor and the telegraph: mental management in British natural philosophy', Unpublished paper, Bodies/Machines Conference, Queen's University Belfast, September 1999.

97 [Wynter], op. cit. (15), 133.

98 J. Verne, *Around the World in Eighty Days*, Harmondsworth, 1996, first published 1873.

99 A. Briggs, *Victorian Things*, Harmondsworth, 1988, Chapter 4, draws attention to the ways in which the telegraph provided a powerful resource for the construction of Victorian fantasies of progressive discipline and control. The point is reiterated in Marvin, op. cit. (93), 109–51, for electricity more generally, though she draws attention as well to the way in which electricity could be used to represent the dangers of untramelled nature.

100 T. Richards, *The Imperial Archive: Knowledge and the Fantasy of Empire*, London, 1993.

Novels such as Kipling's *Kim* or Erskine Childers's *Riddle of the Sands* show how the acquisition of information could be seen as central to imperial preoccupations. Contemporary accounts of the telegraph almost invariably emphasized that what the telegraph did was convey intelligence. It was above all else a way of making intelligence immediately and instantaneously available across the network. This was why the analogy with the body's nervous system worked so well for the Victorians. The important thing about Victorians' brains was that they should be (and be seen to be) in command of their peripheries – their bodies. This also was increasingly what mattered about the Victorian state. The telegraph provided the state with its nervous system and its intelligence-gathering capacity. The key to the analogy was time. The human body could not function if intelligence took time to travel from the extremities through the nerves to the brain. The telegraph also promised society instant intelligence.